

IN THE CLAIMS:

Please amend the claims as follows:

1. (Previously Presented) A method of attaching a self-piercing element in a panel supported on a die member, said self-piercing element including a tubular barrel portion having an open free end including a piercing surface and an integral radial flange portion adjacent said tubular barrel portion including an outer surface having a plurality of spaced inwardly concave surfaces, said die member including a panel supporting end face and a die cavity in said end face including a central die post having an end surface including a piercing surface spaced below the plane of said end face and an annular die cavity surrounding said central die post, said annular die cavity including a semicircular annular bottom surface and a substantially continuous frustoconical side wall having an included angle of between 5 degrees and 12 degrees extending from said semicircular annular bottom surface to said end face, said method comprising the following steps:

supporting a panel on said end face of said die member;

driving said open free end of said tubular barrel portion against said panel and said panel against said end surface of said die post;

continuing to drive said open free end of said barrel portion against said panel, piercing a slug from said panel between said piercing surfaces of said barrel portion and said end surface of said central die post, forming an opening through said panel, and simultaneously deforming a first portion of said panel adjacent said opening into said annular die cavity against an outer surface of said tubular barrel portion;

driving said open free end of said barrel portion against said semicircular annular bottom surface of said annular die cavity, deforming said free open end of said barrel portion radially outwardly and upwardly toward said end face adjacent to but spaced from

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said side wall, forming a U-shaped end portion of said barrel portion, and deforming a pierced edge of said panel portion into said U-shaped end portion of said barrel portion; and

continuously, incrementally deforming a second panel portion in said annular die cavity between said outer surface of said flange portion of said self-piercing element and said side wall of said annular die cavity radially into said inwardly concave surfaces.

2. (Cancelled)

3. (Original) The method as defined in Claim 1, wherein a distance between said continuous frustoconical side wall adjacent said end face and said outer surface of said flange portion is less than the thickness of said panel, said method including thinning said panel at locations between said spaced inwardly concave surfaces.

4. (Previously Presented) The method as defined in Claim 1, wherein said method includes maintaining said first panel portion spaced from an outer wall of said annular die cavity.

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5. (Currently Amended) A method of attaching a self-piercing element in a panel supported on a die member, said self-piercing element including a tubular barrel portion having an open free end and an integral radial flange portion adjacent said tubular barrel portion having a generally cylindrical outer surface including a plurality of circumferentially spaced inwardly concave surfaces, said die member including an end face, a central die post having an end surface spaced below the plane of said end face and an annular die cavity surrounding said central die post, said annular die cavity including an annular semicircular bottom surface and a frustoconical side wall extending tangentially from said semicircular bottom surface to said end face, said method comprising:

supporting a panel on said end face of said die member;

driving said open free end of said barrel portion of said self-piercing element against said panel and said panel against said end surface of said central die post;

continuing to drive said open free end of said barrel portion against said panel, thereby piercing a slug from said panel between said open free end of said barrel portion and said end surface of said central die post and forming an opening in said panel;

~~continuing to drive said open free end of said barrel portion against said panel, thereby piercing a slug from said panel between said open free end of said barrel portion and said end surface of said central die post, forming an opening through said panel, and simultaneously deforming an end~~ a portion of said panel adjacent said opening into said annular die cavity against an external surface of said tubular barrel portion around an intersection of said end face and said continuous frustoconical annular side wall of said die member;

driving said free open end of said barrel portion against said semicircular annular bottom surface of said annular die cavity, thereby deforming said free open end of said barrel portion radially outwardly and upwardly toward said end face and around said end

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portion of said panel, thereby forming a U-shaped end portion of said barrel portion enclosing said end portion of said panel, deforming a pierced edge of said first panel portion in said U-shaped end portion into an enlarged bead having a height measured between said flange portion and said U-shaped end portion of said barrel portion greater than its width; and

continuously, incrementally deforming a second panel portion in said annular die cavity adjacent said end face of said die member between said cylindrical surface of said flange portion and said side wall, thereby thinning said second panel portion and deforming said second panel portion radially into said plurality of spaced inwardly concave surfaces.

6-8 (Cancelled)

9. (Previously Presented) The die member as defined in Claim 24, wherein said continuous frustoconical side wall joins said end face in a radiused surface having a radius of less than 0.04 inches.

10. (Previously Presented) The die member as defined in Claim 24, wherein said outer piercing surface of said die post is defined by an outer annular planar end surface and a frustoconical side wall extending tangentially from said semicircular bottom surface to said outer annular planar surface at an included angle of about 7 degrees.

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11. (Currently Amended) A die member for attaching a self-piercing element having a tubular barrel portion having an open free end and an integral radial flange portion having an outer surface including circumferentially spaced radially projecting portions and concave portions between said radially projecting portions in a panel supported on said die member, said die member comprising:

a generally planar panel-supporting end face, an annular concave die cavity defined in said end face, and a central die post having an outer diameter substantially equal to the inner diameter of the open free end of the tubular barrel portion projecting from said annular concave die cavity toward said end face including an end surface spaced below the plane of said generally planar panel-supporting end face and an annular sharp outer piercing surface adapted to pierce a panel supported on said generally planar panel-supporting surface of the tubular barrel portion of a self-piercing fastener element, said annular concave die cavity surrounding said die post including an annular semicircular bottom surface and a continuous smooth frustoconical outer side wall extending tangentially from said annular semicircular bottom surface to said end face having an included angle of between 6 and 10 degrees.

12. (Original) The die member as defined in Claim 11, wherein said frustoconical outer side wall joins said end face in a radiused surface having a radius of less than 0.04 inches.

13. (Original) The die member as defined in Claim 11, wherein said outer piercing surface of said central die post is defined by an outer annular planar surface and a frustoconical inner surface extending tangentially from said annular semicircular bottom surface to said outer annular planar surface defining a sharp piercing edge.

14-17 (Cancelled)

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18. (Previously Presented) The method as defined in Claim 1, wherein said outer surface of said radial flange portion includes a plurality of circumferentially spaced radially projecting portions and said concave surfaces are defined between said radially projecting portions, said method including driving said radial flange portion against said second panel portion, deforming said second panel portion between said frustoconical side wall of said die member and an outer surface of said radial projections into said concave surfaces.

19. (Previously Presented) The method as defined in Claim 5, wherein said method includes driving said radial flange portion against said second panel portion in said die cavity, deforming said second panel portion between said frustoconical side wall and said generally cylindrical outer surface of said radial flange portion into said spaced inwardly concave surfaces of said flange portion.

20. (Previously Presented) The method as defined in Claim 5, wherein said frustoconical side wall has an included angle of between 5 degrees and 12 degrees and said method including deforming said free open end of said barrel portion upwardly adjacent to but spaced from said frustoconical side wall.

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21. (Currently Amended) A method of attaching a self-piercing element in a panel supported on a die member, said self-piercing element including a tubular barrel portion having an open free end including a piercing surface and an integral radial flange portion including an outer surface, said outer surface of said radial flange portion including a plurality of circumferentially spaced radially outwardly projecting portions separated by concave surfaces, said die member including a panel supporting end face and a die cavity including a central die post having an end surface having an annular piercing surface spaced below a plane of said end face, a concave annular die surface surrounding said die post having a generally semicircular annular bottom surface and a frustoconical side wall adjacent said end face having an included angle of between 5 degrees and 12 degrees, said method comprising the following steps:

supporting a panel on said end face of said die member;

driving said open free end of said tubular barrel portion against said panel and driving a first panel portion into said die cavity against said end face of said die post;

continuing to drive said open free end of said barrel portion against said first portion of said panel, piercing a slug from said panel between said piercing surfaces of said barrel portion and said end face of said central die post, forming an opening through said panel, and simultaneously deforming said first portion of said panel adjacent said opening against said generally semicircular annular bottom surface of said concave die cavity against an outer surface of said tubular barrel portion;

continuing to drive said open free end of said barrel portion against said generally semicircular annular bottom surface of said annular concave die cavity, deforming said free open end of said barrel portion radially outwardly and upwardly toward said end face of said die member, forming a U-shaped end portion of said barrel portion, and

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deforming a pierced edge of said panel into said U-shaped end portion of said barrel portion;
and

driving said radial flange portion against a second panel portion in said die cavity adjacent said end face of said die member, deforming said second panel portion between said frustoconical side wall and outer surfaces of said plurality of circumferentially [space] spaced radially outwardly projecting portions of said outer surface of said radial flange portion and into said concave surfaces defined between said radial projecting portions preventing rotation of said self-piercing element relative to said panel.

22. (Previously Presented) The method as defined in Claim 21, wherein said frustoconical side wall of said die cavity is continuous and extends from said generally semicircular annular bottom surface to said end face of said die member, said method including deforming said free open end of said tubular barrel portion upwardly adjacent to but spaced from said frustoconical side wall.

23. (Previously Presented) The method as defined in Claim 21, wherein said method includes deforming a pierced edge of said first panel portion in said U-shaped end portion having a height measured between said flange portion and said U-shaped end portion of said barrel portion greater than its width.

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24. (Currently Amended) A die member for attaching a self-piercing element to a panel, said self-piercing element including a tubular barrel portion having a free open end and an integral radial flange portion having an outer surface including a plurality of circumferentially spaced radially outwardly projecting portions separated by concave surfaces, said die member comprising:

a planar panel supporting end face and a die cavity defined in said end face including a central die post having an outer diameter generally equal to an inner diameter of the free open end of the tubular barrel portion of the self-piercing element and an end face including ~~an~~ a sharp outer annular piercing surface spaced below a plane of said end face adapted to pierce a panel upon engagement by the free open end of the tubular barrel portion, a concave generally semicircular die surface surrounding said die post and a continuous smooth frustoconical side wall extending tangentially from said concave generally semicircular die surface to said end face having an included angle of between 5 degrees and 12 degrees.